

## LIST OF CONTENTS

### Number 1

**R. R. Wehe and A. W. Westerberg** 1 A bounding procedure for the minimum number of columns in nonsharp distillation sequences

**C. A. Romero and R. H. Davis** 13 Transient model of crossflow microfiltration

**W. L. Kubic, Jr** 27 The stability of metal-water reactions

**D. G. Allen and C. W. Robinson** 37 Measurement of rheological properties of filamentous fermentation broths

**J. O. Valderrama, L. A. Cisternas, M. E. Vergara and M. A. Bosse** 49 Binary interaction parameters in cubic equations of state for hydrogen-hydrocarbon mixtures

**M. L. Hunt and C. L. Tien** 55 Non-Darcian flow, heat and mass transfer in catalytic packed-bed reactors

**I. Celik, T. J. O'Brien and D. B. Godbole** 65 A numerical study of coal devolatilization in an entrained-flow reactor

**S. Ghosh and V. S. Patwardhan** 79 Aqueous solutions of single electrolytes: a correlation based on ionic hydration

**J. Skrzypek, M. Lachowska and D. Serafin** 89 Methanol synthesis from  $\text{CO}_2$  and  $\text{H}_2$ : dependence of equilibrium conversions and exit equilibrium concentrations of components on the main process variables

**T.-B. Liang and M. J. Slater** 97 Liquid-liquid extraction drop formation: mass transfer and the influence of surfactant

**S. Farooq and D. M. Ruthven** 107 A comparison of linear driving force and pore diffusion models for a pressure swing adsorption bulk separation process

**P. A. Aguirre, E. O. Pavani and H. A. Irazoqui** 117 Optimal synthesis of heat-and-power systems with multiple steam levels

**D. D. Frey** 131 The entropy condition for the dynamics of nonlinear multicomponent sorption in porous media

**A. W. Marczewski, A. Derylo-Marczewska and M. Jaroniec** 143 A simple method for describing multi-solute adsorption equilibria on activated carbons

**R. D. Holstvoogd and W. P. M. van Swaaij** 151 The influence of adsorption capacity on enhanced gas absorption in activated carbon slurries

**H. Siddiqui and M. Sahimi** 163 Computer simulations of miscible displacement processes in disordered porous media

**G. F. Versteeg, J. A. M. Kuipers, F. P. H. van Beckum and W. P. M. van Swaaij** 183 Mass transfer with complex reversible chemical reactions—II. Parallel reversible chemical reactions

**Li Jianmin, Wang Shaokun and Shi Jun** 199 Flexibility, multiplicity and symmetry of Wilson parameters and vapor-liquid equilibrium in multicomponent systems

**P. Arteaga and U. Tüzün** 205 Flow of binary mixtures of equal-density granules in hoppers—size segregation, flowing density and discharge rates

**J. A. Schonberg, D. A. Drew and G. Belfort** 225 A neutrally buoyant sphere in creeping flow between parallel plates: farfield velocity profiles

**T. Westerlund and T. Salmi** 237 Factorization of reaction systems applied to catalytic reactions

**K. Warmuziński and J. Buzek** 243 A model of cellular convection during absorption accompanied by chemical reaction

**A. R. Khan and J. F. Richardson** 255 Pressure gradient and friction factor for sedimentation and fluidisation of uniform spheres in liquids

**M. Grzesik, J. Skrzypek and B. W. Wojciechowski** 267 The catalyst decay behaviour in fluidized-bed reactors using the time on stream theory

**H. M. Backes, J. J. Ma, E. Bender and G. Maurer** 275 Interfacial tensions in binary and ternary liquid-liquid systems

**B. J. Hwang and T.-C. Chou** 287 Bias temperature effect on the characteristics of a heterogeneous-homogeneous chain reaction in a semi-batch annular-wall reactor

**J. Moiola, M. C. Colantonio, A. Desages and J. Romagnoli** 297 Bifurcations and degeneracies in a CSTR with reactions  $A \rightarrow B \rightarrow C$ : frequency domain analysis

**K. R. Westerterp and E. J. Westerink** 307 Safe design and operation of tank reactors for multiple-reaction networks: uniqueness and multiplicity

**E. J. Westerink and K. R. Westerterp** 317 Stable design and operation of catalytic fluidized-bed reactors for multiple reactions: uniqueness and multiplicity

**E. J. Westerink and K. R. Westerterp** 333 Safe design and operation of fluidized-bed reactors: choice between reactor models

**J. Y. Day, H. Littman and M. H. Morgan III** 355 *Shorter Communications*  
A new choking velocity correlation for vertical pneumatic conveying

**M. A. Soliman** 360 On the solution of the collocation method equations

**V. M. H. Govindarao, M. Subbanna, A. V. S. Rao and K. V. S. Ramrao** 362 Voidage profile in packed beds by multi-channel model: effects of curvature of the channels

## Number 2

**T. R. Blake, H. Webb and P. B. Sunderland** 365 The nondimensionalization of equations describing fluidization with application to the correlation of jet penetration height

**R. O. Fox and J. Villermieux** 373 Unsteady-state IEM model: numerical simulation and multiple-scale perturbation analysis near perfect-micromixing limit

**J. I. Morell, N. R. Amundson and S.-K. Park** 387 Dynamics of a single particle during char gasification

**E. Gall and W. Kast** 403 Kinetics of sulphur dioxide sorption by single pellets of activated carbon

|                                                                             |                                                                                                                                                                |
|-----------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>D. D. Joseph</b>                                                         | 411 Generalization of the Foscolo-Gibilaro analysis of dynamic waves                                                                                           |
| <b>W. Bujalski, A. W. Nienow and Liu Huoxing</b>                            | 415 The use of upward pumping 45° pitched blade turbine impellers in three-phase reactors                                                                      |
| <b>D. H. Cho, D. R. Armstrong and L. Bova</b>                               | 423 Experimental study of reacting gas jets in liquids: heat release effects                                                                                   |
| <b>H. Hikita, K. Ishimi and S. Koroyasu</b>                                 | 437 Gas desorption from falling liquid films in entrance region of inclined wetted-wall columns with an overflow-type distributor                              |
| <b>M. Goto, J. M. Smith and B. J. McCoy</b>                                 | 443 Parabolic profile approximation (linear driving-force model) for chemical reactions                                                                        |
| <b>V. Jiřičný and V. Staněk</b>                                             | 449 Transients of the hydrodynamics of counter-current packed-bed columns                                                                                      |
| <b>G. W. Stevens and M. H. I. Baird</b>                                     | 457 A model for axial mixing in reciprocating plate columns                                                                                                    |
| <b>R. Banerjee, K. G. Narayankhedkar and S. P. Sukhatme</b>                 | 467 Exergy analysis of pressure swing adsorption processes for air separation                                                                                  |
| <b>G. Buzzi-Ferraris, P. Forzatti and P. Canu</b>                           | 477 An improved version of a sequential design criterion for discriminating among rival multiresponse models                                                   |
| <b>Y. Deng and M. Kwauk</b>                                                 | 483 Levitation of discrete particles in oscillating liquids                                                                                                    |
| <b>S. S. E. H. Elnashaie, A. M. Adris, A. S. Al-Ubaid and M. A. Soliman</b> | 491 On the non-monotonic behaviour of methane-steam reforming kinetics                                                                                         |
| <b>H. J. Viljoen, J. E. Gatica and V. Hlavacek</b>                          | 503 Bifurcation analysis of chemically driven convection                                                                                                       |
| <b>C. C. Lakshmanan and O. E. Potter</b>                                    | 519 Numerical simulation of the dynamics of solids mixing in fluidized beds                                                                                    |
| <b>S. Ichikawa</b>                                                          | 529 Volcano-shaped curves in heterogeneous catalysis                                                                                                           |
| <b>H. I. Andersson and F. Irgens</b>                                        | 537 Hydrodynamic entrance length of non-Newtonian liquid films                                                                                                 |
| <b>W.-T. Tang and L.-S. Fan</b>                                             | 543 Axial liquid mixing in liquid-solid and gas-liquid-solid fluidized beds containing low density particles                                                   |
| <b>S. S. Elshishini and S. S. E. H. Elnashaie</b>                           | 553 Digital simulation of industrial fluid catalytic cracking units: bifurcation and its implications                                                          |
| <b>E. Sobczak</b>                                                           | 561 A simple method of determination of mass transfer coefficients and surface reaction constants for crystal growth                                           |
| <b>F. X. Malcata</b>                                                        | 565 <i>Shorter Communication</i><br>The prediction of mass transfer rates during bubble growth in the presence of an instantaneous reaction on the liquid side |
| Number 3                                                                    |                                                                                                                                                                |
| <b>W. A. Cole and S. P. Goodwin</b>                                         | 569 Flash calculations for gas hydrates: a rigorous approach                                                                                                   |
| <b>J.-K. Chen, A. M. Martin and V. T. John</b>                              | 575 A kinetic analysis of competitive reaction in intrazeolitic media                                                                                          |

|                                                                               |                                                                                                                                |
|-------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|
| <b>S. Karve and V. A. Juvekar</b>                                             | 587 Gas absorption into slurries containing fine catalyst particles                                                            |
| <b>A. C. Kokossis and C. A. Floudas</b>                                       | 595 Optimization of complex reactor networks—I. Isothermal operation                                                           |
| <b>F. Magelli, D. Fajner, M. Nocentini and G. Pasquali</b>                    | 615 Solid distribution in vessels stirred with multiple impellers                                                              |
| <b>C. I. Chiwetelu, V. Hornof and G. H. Neale</b>                             | 627 Mechanisms for the interfacial reaction between acidic oils and alkaline reagents                                          |
| <b>A. Jeje, B. Asante and B. Ross</b>                                         | 639 Steam bubbling regimes and direct contact condensation heat transfer in highly subcooled water                             |
| <b>J. Philip, J. M. Proctor, K. Niranjan and J. F. Davidson</b>               | 651 Gas hold-up and liquid circulation in internal loop reactors containing highly viscous Newtonian and non-Newtonian liquids |
| <b>A. M. Reimus, G. Carta and J. L. Hudson</b>                                | 665 Effects of interfacial diffusive transport on the dynamics of oscillating reactions                                        |
| <b>A. Leitão and A. Rodrigues</b>                                             | 679 Fixed-bed reactor for gasoline sweetening: kinetics of mercaptan oxidation and simulation of the Merox reactor unit        |
| <b>M. R. Davidson</b>                                                         | 687 Flow in the stagnation zone during submerged injection of a swirling gas jet                                               |
| <b>S. Pavlou and C. G. Vayenas</b>                                            | 695 Optimal catalyst activity profile in pellets with shell-progressive poisoning: the case of fast linear kinetics            |
| <b>A. Burghardt and M. Berezowski</b>                                         | 705 Analysis of the structure of steady-state solutions for porous catalytic pellets—first-order reversible reactions          |
| <b>L. E. Sterman and B. E. Ydstie</b>                                         | 721 The steady-state process with periodic perturbations                                                                       |
| <b>L. E. Sterman and B. E. Ydstie</b>                                         | 737 Unsteady-state multivariable analysis of periodically perturbed systems                                                    |
| <b>P. Traub and K. Stephan</b>                                                | 751 High-pressure phase equilibria of the system $\text{CO}_2$ —water-acetone measured with a new apparatus                    |
| <i>Shorter Communications</i>                                                 |                                                                                                                                |
| <b>K. B. Kushalkar and V. G. Pangarkar</b>                                    | 759 Liquid holdup and dispersion in packed columns                                                                             |
| <b>M. Punčochář, J. Drahoš and J. Čermák</b>                                  | 764 The dependence of fluidization regime upon the bed structure at the onset of fluidization                                  |
| <b>K. K. Lee, E. L. Cussler, M. Marchetti and M. A. McHugh</b>                | 766 Pressure-dependent phase transitions in hydrogels                                                                          |
| <i>Letter to the Editors</i>                                                  |                                                                                                                                |
| <b>G. H. Graaf, P. J. J. M. Sijtsema, E. J. Stamhuis and G. E. H. Joosten</b> | 769 On chemical equilibria in methanol synthesis                                                                               |
| <i>Book Review</i>                                                            |                                                                                                                                |
| <b>P. S. Hatton</b>                                                           | 771 Viscous and Compressible Fluid Dynamics. By M. E. O'Neill and F. Chorlton                                                  |

## Number 4

**G. H. Graaf, H. Scholtens,  
E. J. Stamhuis and  
A. A. C. M. Beenackers** 773 Intra-particle diffusion limitations in low-pressure methanol synthesis

**C. Tsouris and L. L. Tavlarides** 785 Dispersed-phase residence times and axial drop velocities in a multistage column contactor

**E. Neau, P. Alessi, M. Fermeglia  
and I. Kikic** 795 Low-pressure equilibrium data for the prediction of solubility in carbon dioxide

**P. Ayazi Shamlou, Z. Liu  
and J. G. Yates** 809 Hydrodynamic influences on particle breakage in fluidized beds

**E. Tsotsas and E.-U. Schlünder** 819 Heat transfer in packed beds with fluid flow: remarks on the meaning and the calculation of a heat transfer coefficient at the wall

**O. Lev, M. Sheintuch, H. Yarnitsky  
and L. M. Pismen** 839 Spatial current distribution during nickel anodic dissolution in sulfuric acid

**H. Nasr-El-Din, J. H. Masliyah  
and K. Nandakumar** 849 Continuous gravity separation of concentrated bidisperse suspensions in a vertical column

**P. E. Savage** 859 Pyrolysis of a binary mixture of complex hydrocarbons: reaction modeling

**E. A. Macedo, P. Skovborg  
and P. Rasmussen** 875 Calculation of phase equilibria for solutions of strong electrolytes in solvent-water mixtures

**J. C. Pinto, M. W. Lobão  
and J. L. Monteiro** 883 Sequential experimental design for parameter estimation: a different approach

**Y. Du and T.-M. Guo** 893 Prediction of hydrate formation for systems containing methanol

**S. Wachi and Y. Nojima** 901 Gas-phase dispersion in bubble columns

**J. Baldyga and J. R. Bourne** 907 The effect of micromixing on parallel reactions

**A. Brunovská, M. Morbidelli  
and P. Brunovský** 917 Optimal catalyst pellet activity distributions for deactivating systems

**L. K. Filippov, I. V. Filippova  
and L. Czeplirski** 927 Technological computation of frontal modes in adsorption separation of multicomponent mixtures

**Y.-M. Chen and L.-S. Fan** 935 Drift flux in gas-liquid-solid fluidized systems from the dynamics of bed collapse

**N. I. Jaeger, R. Ottensmeyer,  
P. J. Plath and H. Engel-Herbert** 947 Dynamics of the heterogeneous catalytic oxidation of ethanol—I. Analysis of experimental bifurcation diagrams

**H. Engel-Herbert, P. J. Plath,  
R. Ottensmeyer, Th. Schnelle  
and J. Kaldasch** 955 Dynamics of the heterogeneous catalytic oxidation of ethanol—II. Qualitative modelling of dynamic features

**D. C. Arters and L.-S. Fan** 965 Experimental methods and correlation of solid-liquid mass transfer in fluidized beds

**G. Li and H. Rabitz** 977 A general analysis of approximate lumping in chemical kinetics

**J. Zhu, J. R. Grace and C. J. Lim** 1003 Tube wear in gas fluidized beds—I. Experimental findings

**J. T. Hsu and U. P. Ernst** 1017 Theoretical studies of reaction chromatograms by the Fast Fourier Transform technique

**J. Gram, M. de Bang and J. Villadsen** 1031 An automated glucose isomerase reactor system with online flow injection analyzers for monitoring of pH, glucose and fructose concentrations

**S. A. K. Jelani, N. Fidi and S. Hartland** 1043 Foam formation during  $\text{CO}_2$  desorption from agitated supersaturated aqueous surfactant solutions

**T. Akiyama, Y. Nakano, Y. Tanijiri, H. Kazama and H. Fujiyasu** 1049 Characteristics of evaporated stearic acid films prepared by the hot wall technique

**R.-H. Jean and L.-S. Fan** 1057 Rise velocity and gas-liquid mass transfer of a single large bubble in liquids and liquid-solid fluidized beds

**A. E. Almstedt and V. Zakkay** 1071 An investigation of fluidized-bed scaling—capacitance probe measurements in a pressurized fluidized-bed combustor and a cold model bed

**H. A. Dijkstra and A. A. H. Drinkenburg** 1079 Enlargement of wetted area and mass transfer due to surface tension gradients: the creeping film phenomenon

**D. T. Lynch and N. P. Walters** 1089 Frequency response characterization of reaction systems: external recycle reactor with a solid adsorbent

**X. Lu, R. Madey, D. Rothstein, M. Jaroniec and J.-C. Huang** 1097 Pressure swing adsorption for a system with a Langmuir-Freundlich isotherm

**J. G. Yates, R. S. Ruiz-Martinez and D. J. Cheesman** 1105 Prediction of bubble size in a fluidized bed containing horizontal tubes

**J. T. Tinge, H. A. Dijkstra, J. Boelen, C. J. C. Stoelwinder and A. A. H. Drinkenburg** 1113 Gas separation in a three-phase bubble column

**S. C. Saxena and S. Shrivastava** *Shorter Communications*  
1125 The influence of an external magnetic field on an air-fluidized bed of ferromagnetic particles

**S. S. Bhagwat** 1130 Gas-liquid-solid reactions: importance of fine bubbles near solid-liquid interface

**R. Lortie and G. André** 1133 On the use of apparent kinetic parameters for enzyme-bearing particles with internal mass-transfer limitations

**A. A. Shaikh and S. M. Zarook** 1137 Some remarks on the effect of flow direction on steady-state multiplicity in bubble column reactors

**S. V. Jadhav and V. G. Pangarkar** 1139 Solid-liquid mass transfer in packed bubble columns

**J. C. Smeltzer and P. S. Fedkiw** 1144 Surface-concentration behavior in the presence of an oscillating reactant flux to the wall

**Y. Shirai, M. Louhi, S. Palosaari, K. Nakanishi and R. Matsuno** *Letter to the Editors*  
1147 Comments on the prediction of ice crystal size distribution in a continuous crystallizer

**R. J. Wakeman** *Book Reviews*  
1149 Crossflow Filtration. By J. Murkes and C. G. Carlsson

**G. S. Virk** 1149 Robust Process Control. By M. Morari and E. Zafiriou

**H. Hofmann**

1150 DECHEMA Chemistry Data Series. Edited by D. Behrens and R. Eckermann. Vol. 1, Part 1b, Vapour-Liquid Equilibrium Data Collection, Aqueous Systems (Supplement 2). By J. Gmeling, U. Onken and J. R. Rarey-Nies. Vol. 1, Part 2e, Vapour-Liquid Equilibrium Data Collection, Organic Hydroxy Compounds: Alcohols (Supplement 3). By J. Gmeling, U. Onken and J. R. Rarey-Nies. Vol. 5, Part 4, Liquid-Liquid Equilibrium Data Collection (Supplement 1). By E. A. Macedo and P. Rasmussen.

## Number 5

**A. N. Bhaskarwar, D. Desai and R. Kumar**

1151 General model of a foam bed reactor

**U. Sedran, A. Mahay and H. I. de Las**

1161 Modelling methanol conversion to hydrocarbons: revision and testing of a simple kinetic model

**H. Bosch, G. F. Versteeg and W. P. M. van Swaaij**

1167 Kinetics of the reaction of CO<sub>2</sub> with the sterically hindered amine 2-amino-2-methylpropanol at 298 K

**J. S. Dennis and A. N. Hayhurst**

1175 Mechanism of the sulphation of calcined limestone particles in combustion gases

**R. A. Bortolozzi and J. A. Deiber**

1189 Mass transfer between growing air bubbles and an emulsion of coal particles in fluidized gasification and combustion

**Y. Taitel and D. Barnea**

1199 A consistent approach for calculating pressure drop in inclined slug flow

**C. Bernot, M. F. Doherty and M. F. Malone**

1207 Patterns of composition change in multicomponent batch distillation

**M. Bentrcia and D. A. Drew**

1223 Fouling layer growth and distribution at the interface of pressure-driven membranes

**M. R. Mackley, G. M. Tweddle and I. D. Wyatt**

1237 Experimental heat transfer measurements for pulsatile flow in baffled tubes

**I. Molnár, S. Halász and T. Bickle**

1243 Determination of size-dependent crystal growth characteristics from batch experiments

**N. S. Srinivasan and L.-I. Staffansson**

1253 A theoretical analysis of the fluidized-bed process for the reduction of iron ores

**M. Atiqullah and E. B. Nauman**

1267 A model and measurement technique for micromixing in copolymerization reactors

**D. Herskowits, V. Herskowits, K. Stephan and A. Tamir**

1281 Characterization of a two-phase impinging jet absorber—II. Absorption with chemical reaction of CO<sub>2</sub> in NaOH solutions

**H.-S. Liu and H.-W. Hsu**

1289 Analysis of gas stripping during ethanol fermentation—I. In a continuous stirred tank reactor

**E. Bauman, A. Varma, J. Lorusso, M. Dente and M. Morbidelli**

1301 Parametric sensitivity in tubular reactors with co-current external cooling

**J.-W. Chang and C.-C. Yu**

1309 The relative gain for non-square multivariable systems

**M. Berezowski**

1325 A sufficient condition for the existence of single steady states in chemical reactors with recycle

|                                                       |                                                                                                                                  |
|-------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>J. Adaje and M. Sheintuch</b>                      | 1331 Comparison of multiplicity patterns of a single catalytic pellet and a fixed catalytic bed for ethylene oxidation           |
| <b>R. W. Field</b>                                    | 1343 A theoretical viscosity correction factor for heat transfer and friction in pipe flow                                       |
| <b>T. Howes and M. R. Mackley</b>                     | 1349 Experimental axial dispersion for oscillatory flow through a baffled tube                                                   |
| <b>H. W. Chandler and J. H. Song</b>                  | 1359 A variational principle for the compaction of granular materials                                                            |
| <b>J. S. Yoo and H. H. Lee</b>                        | 1367 A sufficient condition for stability of catalyst pellet system with unit Lewis number                                       |
| <b>D. D. Do</b>                                       | 1373 Hierarchy of rate models for adsorption and desorption in bidispersed structured sorbents                                   |
| <b>J. C. R. Turner</b>                                | 1383 Taylor dispersion of expanding gases in pipe flow                                                                           |
| <b>A. I. Jomha, M. F. Edwards and L. V. Woodcock</b>  | 1389 New method for predicting the power requirement for mixing shear thickening suspensions                                     |
| <b>W. A. Cole and W. A. Wakeham</b>                   | 1397 Prediction of the thermodynamic properties of sulphur hexafluoride                                                          |
| <b>P. Ayazi Shamlou, A. G. Jones and K. Djamarani</b> | 1405 Hydrodynamics of secondary nucleation in suspension crystallization                                                         |
| <b>R. Zarzycki, A. Chacuk, M. Starzak and E. Nagy</b> | 1417 <i>Shorter Communications</i><br>Remarks on using the film model in physical and chemical mass transfer in the liquid phase |
| <b>D. D. Do and R. G. Rice</b>                        | 1419 Applicability of the external-diffusion model in adsorption studies                                                         |
| <b>B. K. Cho</b>                                      | 1422 Determination of coverage-dependent heat of adsorption from transient pulse experiments                                     |
| <b>E. Van den Bulck</b>                               | 1425 Isotherm correlation for water vapor on regular-density silica gel                                                          |
| <b>K. Tsuchiya, G.-H. Song and L.-S. Fan</b>          | 1429 Effects of particle properties on bubble rise and wake in a two-dimensional liquid-solid fluidized bed                      |
| <b>A. Arrowsmith</b>                                  | 1435 <i>Book Review</i><br>Atomization and Sprays. By A. H. Lefebvre                                                             |
|                                                       | 1437 Corrigendum                                                                                                                 |
|                                                       | 1439 <i>Obituary</i><br>Professor J. M. Coulson                                                                                  |
|                                                       | 1441 <i>Announcement</i><br>Chemical Engineering Science Special Issue: Symposium in Print on Bioseparations                     |

## Number 6

|                                                   |                                                                                                                 |
|---------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|
| <b>M. Sahimi, G. R. Gavalas and T. T. Tsotsis</b> | 1443 <b>Review Article Number 32. Statistical and continuum models of fluid-solid reactions in porous media</b> |
| <b>D. Dimitrelis and J. M. Prausnitz</b>          | 1503 Molecular thermodynamics of fluid mixtures at low and high densities                                       |

|                                                                                        |                                                                                                                                                                  |
|----------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>R. A. Novy, H. T. Davis<br/>and L. E. Scriven</b>                                   | 1515 Upstream and downstream boundary conditions for continuous-flow systems                                                                                     |
| <b>A. Mehra</b>                                                                        | 1525 Gas absorption in slurries of finite-capacity microparticles                                                                                                |
| <b>M. Jaroniec, X. Lu, R. Madey<br/>and J. Choma</b>                                   | 1539 Comparative studies of adsorption of ethane and benzene on microporous activated carbons                                                                    |
| <b>A. A. P. de Alwis and P. J. Fryer</b>                                               | 1547 A finite-element analysis of heat generation and transfer during ohmic heating of food                                                                      |
| <b>L. G. Gibiliaro, R. Di Felice<br/>and P. U. Foscolo</b>                             | 1561 Added mass effects in fluidized beds: application of the Geurst-Wallis analysis of inertial coupling in two-phase flow                                      |
| <b>D. A. White</b>                                                                     | 1567 Gas diffusion cascades—properties and optimization                                                                                                          |
| <b>M. F. Larrousse and W. R. Wilcox</b>                                                | 1571 Interfacial mass transfer to a cylinder endwall during spin-up/spin-down                                                                                    |
| <b>C. F. Mignone</b>                                                                   | 1583 The agitation-step method for $K_L a$ measurement                                                                                                           |
| <b>B. W. Brooks</b>                                                                    | 1589 Product yields from the Van de Vusse reaction scheme: use of semi-batch reactors                                                                            |
| <b>J. I. Ramos and R. Pitchumani</b>                                                   | 1595 Liquid curtains—II. Gas absorption                                                                                                                          |
| <b>A. Rehfinger and U. Hoffmann</b>                                                    | 1605 Kinetics of methyl tertiary butyl ether liquid phase synthesis catalyzed by ion exchange resin—I. Intrinsic rate expression in liquid phase activities      |
| <b>A. Rehfinger and U. Hoffmann</b>                                                    | 1619 Kinetics of methyl tertiary butyl ether liquid phase synthesis catalyzed by ion exchange resin—II. Macropore diffusion of methanol as rate-controlling step |
| <b>K. Rietema and H. W. Piepers</b>                                                    | 1627 The effect of interparticle forces on the stability of gas-fluidized beds—I. Experimental evidence                                                          |
| <b>S. P. Crockett and W. H. Smyrl</b>                                                  | 1641 <i>Shorter Communications</i><br>A single expansion treatment of fluid motion at a rotating disk                                                            |
| <b>R. Baratti, G. Cao, M. Morbidelli<br/>and A. Varma</b>                              | 1643 Optimal activity distribution in nonuniformly impregnated catalyst particles: numerical analysis                                                            |
| <b>P. U. Foscolo, R. Di Felice,<br/>L. G. Gibiliaro, L. Pistone<br/>and V. Piccolo</b> | 1647 Scaling relationships for fluidisation: the generalised particle bed model                                                                                  |
| <b>J. R. Nebrensky</b>                                                                 | <i>Letters to the Editors</i><br>1653 Comments on predicting the free-fall velocities of spheres                                                                 |
| <b>M. Hartman</b>                                                                      | 1653 Author's reply to comments by J. R. Nebrensky                                                                                                               |
| <b>A. Pethö</b>                                                                        | 1654 Further to the Aris <i>Festschrift</i>                                                                                                                      |
| <b>P. N. Rowe</b>                                                                      | <i>Book Reviews</i><br>1655 Gas-Liquid-Solid Fluidization Engineering. By L.-S. Fan                                                                              |
| <b>A. W. Deakin</b>                                                                    | 1655 Aerosol Sampling Science and Practice. By J. H. Vincent                                                                                                     |
| <b>W. A. Wakeham</b>                                                                   | 1656 Heats of Vaporization of Fluids. By V. Majer, V. Svoboda and J. Pick                                                                                        |
| <b>R. E. Franklin</b>                                                                  | 1656 Fluid Dynamics and Flow-induced Vibrations of Tube Banks. By A. Zukanskas, R. Ulinskas and V. Katinas                                                       |

**N. Thomas** 1656 Physicochemical Hydrodynamics. By R. F. Probstein  
**J. M. Winterbottom** 1657 Catalyst Handbook. Edited by M. V. Twigg

## Number 7

**G. A. Cordonier, L. D. Schmidt and R. Aris** 1659 Forced oscillations of chemical reactors with multiple steady states

**M. J. Ellman, N. Midoux, G. Wild, A. Laurent and J. C. Charpentier** 1677 A new, improved liquid hold-up correlation for trickle-bed reactors

**R. Krupiczka, A. Rotkegel, K. Oswatitsch and W. Hantsch** 1685 Selectivity during condensation of binary mixtures in a nozzle with countercurrent flow of vapour and condensate

**J. C. P. Wang, F. R. Groves and D. P. Harrison** 1693 Modeling high temperature desulfurization in a fixed-bed reactor

**J. J. Frijlink, A. Bakker and J. M. Smith** 1703 Suspension of solid particles with gassed impellers

**G. C. Stangle and I. A. Aksay** 1719 Simultaneous momentum, heat and mass transfer with chemical reaction in a disordered porous medium: application to binder removal from a ceramic green body

**P. A. Olowson and A. E. Almstedt** 1733 Influence of pressure and fluidization velocity on the bubble behaviour and gas flow distribution in a fluidized bed

**M. Lebrun and B. Spinner** 1743 Models of heat and mass transfers in solid-gas reactors used as chemical heat pumps

**T. G. Lenz and J. D. Vaughan** 1755 Computer-based molecular mechanics techniques for accurate prediction of thermodynamic properties of chemically reactive systems

**M. P. Schwarz** 1765 Sloshing waves formed in gas-agitated baths

**R. Krishna** 1779 Multicomponent surface diffusion of adsorbed species: a description based on the generalized Maxwell-Stefan equations

**S. A. Godorr, B. D. Young and A. W. Bryson** 1793 Characterising and modelling of the growth of a rough surface

**V. Julka and M. F. Doherty** 1801 Geometric behavior and minimum flows for nonideal multicomponent distillation

**H. N. Pham and M. F. Doherty** 1823 Design and synthesis of heterogeneous azeotropic distillations—I. Heterogeneous phase diagrams

**H. N. Pham and M. F. Doherty** 1837 Design and synthesis of heterogeneous azeotropic distillations—II. Residue curve maps

**H. N. Pham and M. F. Doherty** 1845 Design and synthesis of heterogeneous azeotropic distillations—III. Column sequences

**H. Wu, A. Brunovská, M. Morbidelli and A. Varma** 1855 Optimal catalyst activity profiles in pellets—VIII. General nonisothermal reacting systems with arbitrary kinetics

**J. Moiola, A. Desages and J. Romagnoli** 1863 Bifurcations in chemical reactors via feedback system theory

|                                                                                                               |      |                                                                                                                                                                                |
|---------------------------------------------------------------------------------------------------------------|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>H. A. J. Kennis, Th. W. de Loos,<br/>J. de Swaan Arons,<br/>R. Van der Haegen<br/>and L. A. Kleintjens</b> | 1875 | The influence of nitrogen on the liquid-liquid phase behaviour of the system n-hexane-polyethylene: experimental results and predictions with the mean-field lattice-gas model |
| <b>M. P. Srinivasan, J. M. Smith<br/>and B. J. McCoy</b>                                                      | 1885 | Supercritical fluid desorption from activated carbon                                                                                                                           |
| <b>M. Sheintuch and J. Adjaye</b>                                                                             | 1897 | Excitable waves in a fixed bed reactor: ethylene oxidation on platinum                                                                                                         |
| <b>G. Brem and J. J. H. Brouwers</b>                                                                          | 1905 | Analytical solutions for non-linear conversion of a porous solid particle in a gas—I. Isothermal conversion                                                                    |
| <b>G. Brem and J. J. H. Brouwers</b>                                                                          | 1915 | Analytical solutions for non-linear conversion of a porous solid particle in a gas—II. Non-isothermal conversion and numerical verification                                    |
| <i>Shorter Communications</i>                                                                                 |      |                                                                                                                                                                                |
| <b>M. A. Soliman and<br/>S. S. E. H. Elnashaie</b>                                                            | 1925 | Negative effectiveness factors for cyclic reversible reactions                                                                                                                 |
| <b>J. Jezowski</b>                                                                                            | 1928 | A simple synthesis method for heat exchanger networks with minimum number of matches                                                                                           |
| <b>R. B. Keey</b>                                                                                             | 1933 | The influence of feeding irregularities on the through-circulation drying of loose materials                                                                                   |
| <b>R. A. Rajadhyaksha, K. K. Pitale<br/>and S. S. Tambe</b>                                                   | 1935 | Correlation effects in counterdiffusion in zeolites                                                                                                                            |
| <i>Letters to the Editors</i>                                                                                 |      |                                                                                                                                                                                |
| <b>B. S. Balzhinimaev, N. P. Belyaeva<br/>and S. I. Reshetnikov</b>                                           | 1939 | Comments on modelling of SO <sub>2</sub> oxidation rates based on kinetic data of a Cs/V catalyst at high pressures and conversions                                            |
| <b>F. J. Doering</b>                                                                                          | 1941 | Author's reply to comments by Balzhinimaev <i>et al.</i>                                                                                                                       |
| <i>Book Review</i>                                                                                            |      |                                                                                                                                                                                |
| <b>R. R. Hudgins</b>                                                                                          | 1943 | Catalytic Processes under Unsteady-state Conditions.<br>By Yu. Sh. Matros                                                                                                      |

## Number 8

## Special issue: ISCRE 11

|                                                          |      |                                                                       |
|----------------------------------------------------------|------|-----------------------------------------------------------------------|
| <b>J. Wei</b>                                            | ix   | Preface                                                               |
| <b>J. R. Grace</b>                                       | xi   | List of reviewers                                                     |
| <b>Plenary papers</b>                                    |      |                                                                       |
| <b>J. R. Grace</b>                                       | 1947 | P1. New horizons in reaction engineering                              |
| <b>R. Langer, H. Bernstein, L. Brown<br/>and L. Cima</b> | 1953 | P2. High-velocity fluidized bed reactors                              |
| <b>D. Luss</b>                                           | 1967 | P3. Medical reactors                                                  |
| <b>R. A. van Santen</b>                                  | 1979 | P4. Reaction engineering of advanced ceramic materials                |
| <b>A. T. Bell</b>                                        | 2001 | P5. Computational advances in catalyst modelling                      |
| <b>L. L. Hegedus and C. J. Pereira</b>                   | 2013 | P6. The impact of catalyst science on catalyst design and development |
| <b>J. H. Seinfeld</b>                                    | 2027 | P7. Reaction engineering for catalyst design                          |
|                                                          | 2045 | P8. The environment and chemical reaction engineering                 |

|                                                                                                 |                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>C. LaMarca, C. Libanati and M. T. Klein</b>                                                  | <b>Session A: modeling and scaleup</b>                                                                                                                |
|                                                                                                 | 2059 A1. Design of kinetically coupled complex reaction systems                                                                                       |
| <b>A. Rastogi, A. Vega, C. Georgakis and H. G. Stenger, Jr.</b>                                 | 2067 A2. Optimization of catalyzed epoxidation of unsaturated fatty acids by using tendency models                                                    |
| <b>J. L. Hudson, M. Kube, R. A. Adomaitis, I. G. Kevrekidis, A. S. Lapedes and R. M. Farber</b> | 2075 A3. Nonlinear signal processing and system identification: applications to time series from electrochemical reactions                            |
| <b>M. Neurock, C. Libanati, A. Nigam and M. T. Klein</b>                                        | 2083 A4. Monte Carlo simulation of complex reaction systems: molecular structure and reactivity in modelling heavy oils                               |
| <b>A. O. E. Beyne and G. F. Froment</b>                                                         | 2089 A5. A percolation approach for the modeling of deactivation of zeolite catalysts by coke formation                                               |
| <b>Yu. Sh. Matros</b>                                                                           | 2097 A6. Performance of catalytic processes under unsteady conditions                                                                                 |
| <b>E. C. Martinez and L. J. Beltramini</b>                                                      | 2103 A7. Lumping upon time-scales: modeling upon topological factors                                                                                  |
| <b>N. A. Bhowe, M. T. Klein and K. B. Bischoff</b>                                              | 2109 A8. Species rank in reaction pathways: application of Delplot analysis                                                                           |
| <b>H. van der Eijk, G. J. den Otter, P. M. M. Blaauwhoff and I. E. Maxwell</b>                  | 2117 A9. The application of advanced process models in oil refining R & D                                                                             |
| <b>M. Sheintuch</b>                                                                             | 2125 A10. Excitable waves in a fixed bed reactor: observations and analysis                                                                           |
| <b>E. G. Bauman and A. Varma</b>                                                                | 2133 A11. Parametric sensitivity and runaway in catalytic reactors: experiments and theory using carbon monoxide oxidation as an example              |
| <b>R. Küfner and H. Hofmann</b>                                                                 | 2141 A12. Implementation of radial porosity and velocity distribution in a reactor model for heterogeneous catalytic gasphase reactions (TORUS-model) |
| <b>R. R. Natu and U. V. Shenoy</b>                                                              | 2147 A13. A new micromixing model for turbulent reactors                                                                                              |
| <b>D. L. Weidman and W. E. Stewart</b>                                                          | 2155 A14. Catalyst particle modelling in fixed-bed reactors                                                                                           |
| <b>D. Hildebrandt and D. Glasser</b>                                                            | 2161 A15. The attainable region and optimal reactor structures                                                                                        |
| <b>D. Suter, A. Bartroli, F. Schneider, D. W. T. Rippin and E. J. Newson</b>                    | 2169 A16. Radial flow reactor optimization for highly exothermic selective oxidation reactions                                                        |
| <b>P. A. Ambler, B. J. Milne, F. Berruti and D. S. Scott</b>                                    | <b>Session B: multiphase reactors</b>                                                                                                                 |
| <b>G. Sun and J. R. Grace</b>                                                                   | 2179 B1. Residence time distribution of solids in a circulating fluidized bed: experimental and modelling studies                                     |
| <b>M. C. Phillips</b>                                                                           | 2187 B2. The effect of particle size distribution on the performance of a catalytic fluidized bed reactor                                             |
|                                                                                                 | 2195 B3. A parametric sensitivity study on the relative importance of packet formation and single-particle motion in fluidized bed heat transfer      |

|                                                                                                       |      |                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>A. V. Sapre, T. M. Leib and D. H. Anderson</b>                                                     | 2203 | B4. FCC regenerator flow model                                                                                                        |
| <b>C. E. J. van Lare, H. W. Piepers and D. Thoenes</b>                                                | 2211 | B5. Scaling and particle size optimization of mass transfer in gas fluidized beds                                                     |
| <b>A. Gianetto, S. Pagliolico, G. Rovero and B. Ruggeri</b>                                           | 2219 | B6. Theoretical and practical aspects of circulating fluidized bed reactors (CFBRs) for complex chemical systems                      |
| <b>T. Baron, C. L. Briens, P. Galtier and M. A. Bergougnou</b>                                        | 2227 | B7. Verification of models and correlations for bubble properties in fluidized beds                                                   |
| <b>A. Zaidi, W.-D. Deckwer, A. Mrani and B. Benchekchou</b>                                           | 2235 | B8. Hydrodynamics and heat transfer in three-phase fluidized beds with highly viscous pseudoplastic solutions                         |
| <b>D. C. Dankworth, I. G. Kevrekidis and S. Sundaresan</b>                                            | 2239 | B9. Time dependent hydrodynamics in multiphase reactors                                                                               |
| <b>W. J. A. Wammes and K. R. Westerterp</b>                                                           | 2247 | B10. The influence of the reactor pressure on the hydrodynamics in a cocurrent gas-liquid trickle-bed reactor                         |
| <b>P. M. Haure, S. M. Bogdashev, M. Bunimovich, A. N. Stegasov, R. R. Hudgins and P. L. Silveston</b> | 2255 | B11. Thermal waves in the periodic operation of a trickle-bed reactor                                                                 |
| <b>A. V. Sapre, D. H. Anderson and F. J. Krambeck</b>                                                 | 2263 | B12. Heater probe technique to measure flow maldistribution in large scale trickle bed reactors                                       |
| <b>P. Trambouze</b>                                                                                   | 2269 | B13. Countercurrent two-phase flow fixed bed catalytic reactors                                                                       |
| <b>L. van Dierendonck, T. Smets, S. Sicardi, L. Manna and G. Baldi</b>                                | 2277 | B14. A new model for the kinetics study of a multiphase batch reactor                                                                 |
| <b>N. Devanathan, D. Moslemian and M. P. Dudukovic</b>                                                | 2285 | B15. Flow mapping in bubble columns using CARPT                                                                                       |
| <b>I. G. Reilly, D. S. Scott, T. J. W. de Brujin, D. MacIntyre and J. Piskorz</b>                     | 2293 | B16. Axial solids concentrations in three-phase bubble columns                                                                        |
| <b>K. N. Clark</b>                                                                                    | 2301 | B17. The effect of high pressure and temperature on phase distributions in a bubble column                                            |
| <b>P. M. Wilkinson and L. L. v. Dierendonck</b>                                                       | 2309 | B18. Pressure and gas density effects on bubble break-up and gas hold-up in bubble columns                                            |
| <b>J. R. Turner and P. L. Mills</b>                                                                   | 2317 | B19. Comparison of axial dispersion and mixing cell models for design and simulation of Fischer-Tropsch slurry bubble column reactors |
| <b>R. Torvik and H. F. Svendsen</b>                                                                   | 2325 | B20. Modelling of slurry reactors. A fundamental approach                                                                             |
| <b>C. A. M. C. Dirix and K. van der Wiele</b>                                                         | 2333 | B21. Mass transfer in jet loop reactors                                                                                               |
| <b>K. Scott and B. Hayati</b>                                                                         | 2341 | B22. The multiphase electrochemical synthesis of adiponitrile                                                                         |
| <b>S. G. Hatzikiriakos, R. P. Gaikwad and J. M. Shaw</b>                                              | 2349 | B23. Transitional drop size distributions in gas agitated liquid-liquid dispersions                                                   |

|                                                                                              |                                                                                                                                       |
|----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|
| <b>K. Zygourakis</b>                                                                         | <b>Session C: biochemical and biomedical reaction engineering</b>                                                                     |
| 2359                                                                                         | C1. Development and temporal evolution of erosion fronts in bioerodible controlled release devices                                    |
| <b>C. Starbuck, H. S. Wiley and D. A. Lauffenburger</b>                                      | 2367 C2. Epidermal growth factor binding and trafficking dynamics in fibroblasts: relationship to cell proliferation                  |
| <b>R. J. De Boer, I. G. Kevrekidis and A. S. Perelson</b>                                    | 2375 C3. A simple idiotypic network model with complex dynamics                                                                       |
| <b>C. Ongcharit, Y. T. Shah and K. L. Sublette</b>                                           | 2383 C4. Novel immobilized cell reactor for microbial oxidation of H <sub>2</sub> S                                                   |
| <b>J. M. Woodley and M. D. Lilly</b>                                                         | 2391 C5. Extractive biocatalysis: the use of two-liquid phase biocatalytic reactors to assist product recovery                        |
| <b>L. A. M. van der Wielen, J. J. M. Potters, A. J. J. Straathof and K. Ch. A. M. Luyben</b> | 2397 C6. Integration of bioconversion and continuous product separation by means of countercurrent adsorption                         |
| <b>R. F. Blanks, T. S. Wittrig and D. A. Peterson</b>                                        | <b>Session D: novel reactors</b>                                                                                                      |
|                                                                                              | 2407 D1. Bidirectional adiabatic synthesis gas generator                                                                              |
| <b>H. J. Sloot, G. F. Versteeg and W. P. M. van Swaaij</b>                                   | 2415 D2. A non-permselective membrane reactor for chemical processes normally requiring strict stoichiometric feed rates of reactants |
| <b>A. M. Champagnie, T. T. Tsotsis, R. G. Minet and I. A. Webster</b>                        | 2423 D3. A high temperature catalytic membrane reactor for ethane dehydrogenation                                                     |
| <b>A. Ray, A. L. Tonkovich, R. Aris and R. W. Carr</b>                                       | 2431 D4. The simulated countercurrent moving bed chromatographic reactor                                                              |
| <b>M. I. Cabrera, O. M. Alfano and A. E. Cassano</b>                                         | 2439 D5. Product yield and selectivity studies in photoreactor design. Theory and experiments for the chlorination of methane         |
| <b>D. W. Kraemer, U. Sedran and H. I. de Lasa</b>                                            | 2447 D6. Catalytic cracking kinetics in a novel riser simulator                                                                       |
| <b>W. H. Gauvin</b>                                                                          | 2453 D7. Novel reactors for plasma applications                                                                                       |
| <b>H. Zhu, Y. C. Lau and E. Pfender</b>                                                      | 2461 D8. Deposition of YBa <sub>2</sub> Cu <sub>3</sub> O <sub>7-x</sub> thick films using an RF thermal plasma reactor               |
| <b>I. Zouari, F. Lapicque, M. Calvo and M. Cabrera</b>                                       | 2467 D9. Laser assisted metal electrodeposition: comprehensive investigation of zinc deposition                                       |
| <b>M. Douyon de Azevedo and J.-L. Meunier</b>                                                | 2475 D10. Ionic flux distributions for the vacuum arc deposition of diamondlike films                                                 |
| <b>C. B. Lafiamme, J. W. Jurewicz, D. V. Gravelle and M. I. Boulos</b>                       | 2483 D11. Thermal plasma reactor for the processing of gaseous hydrocarbons                                                           |
| <b>R. J. Munz and O. S. Mersereau</b>                                                        | 2489 D12. A plasma spout-fluid bed for the recovery of vanadium from vanadium ore                                                     |
| <b>H. W. Dandekar, C. C. Agrafiotis, J. A. Puszynski and V. Hlavacek</b>                     | <b>Session E: material processing</b>                                                                                                 |
|                                                                                              | 2499 E1. Modeling and analysis of filtration combustion for synthesis of transition metal nitrides                                    |
| <b>P. McAllister and E. E. Wolf</b>                                                          | 2505 E2. Modeling of chemical vapor infiltration of carbon composites with pyrolytic carbon                                           |

|                                                                                |      |                                                                                                                                                                           |
|--------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>P. E. Price Jr. and K. F. Jensen</b>                                        | 2511 | E3. Optically induced bifurcations in laser direct-write metallization                                                                                                    |
| <b>M. P. Duduković, J. L. Kardos, I. S. Yoon and Y. B. Yang</b>                | 2519 | E4. Autoclave processing of long fiber thermoplastic composites                                                                                                           |
| <b>T. Kojima, T. Kimura and M. Matsukata</b>                                   | 2527 | E5. Development of numerical model for reactions in fluidized bed grid zone—application to chemical vapor deposition of polycrystalline silicon by monosilane pyrolysis   |
| <b>K. A. Pilcher and J. Bridgwater</b>                                         | 2535 | E6. Pinning in a rectangular moving bed reactor with gas cross-flow                                                                                                       |
| <b>J. H. Scholtz, J. E. Gatica, H. J. Viljoen, V. Revankar and V. Hlavacek</b> | 2543 | E7. CVD reactors for the synthesis of inorganic fibers. Modeling and experimental evaluation                                                                              |
| <b>M. R. Zachariah</b>                                                         | 2551 | E8. Modeling ceramic sub-micron particle formation from the vapor using detailed chemical kinetics: comparison with in situ laser diagnostics                             |
| <b>Session F: catalyst design</b>                                              |      |                                                                                                                                                                           |
| <b>I. E. Wachs</b>                                                             | 2561 | F1. Molecular engineering of supported metal oxide catalysts                                                                                                              |
| <b>D. S. Lafyatis and H. C. Foley</b>                                          | 2567 | F2. Molecular modelling of the shape selectivity for the Fischer-Tropsch reaction using a tri-functional catalyst                                                         |
| <b>M. Hoffmeister and D. Hesse</b>                                             | 2575 | F3. The influence of the pore structure of the support on the properties of supported liquid-phase catalysts                                                              |
| <b>W. Suarez, W.-C. Cheng, K. Rajagopalan and A. W. Peters</b>                 | 2581 | F4. Estimation of hydrogen transfer rates over zeolite catalysts                                                                                                          |
| <b>G. Centi and F. Trifiro</b>                                                 | 2589 | F5. Surface kinetics of adsorbed intermediates: selective oxidation of C <sub>4</sub> –C <sub>5</sub> alkanes                                                             |
| <b>J. C. Kellow and E. E. Wolf</b>                                             | 2597 | F6. Infrared thermography and FTIR studies of catalyst preparation effects on surface reaction dynamics during CO and ethylene oxidation on Rh/SiO <sub>2</sub> catalysts |
| <b>J. W. Beeckman</b>                                                          | 2603 | F7. Mathematical description of heterogeneous materials                                                                                                                   |
| <b>C. L. Cui, J. R. Authelin, D. Schweich and J. Villermaux</b>                | 2611 | F8. Consequence of distributed properties on effective diffusivities in porous solids                                                                                     |
| <b>D. B. Dadyburjor and C. W. White III</b>                                    | 2619 | F9. Effect of position-dependent deactivation on the design of a composite cracking catalyst                                                                              |
| <b>P.-S. E. Dai, D. E. Sherwood and B. R. Martin</b>                           | 2625 | F10. Effect of diffusion on resid hydrodesulfurization activity                                                                                                           |
| <b>T. C. Ho and S. C. Reyes</b>                                                | 2633 | F11. Design of catalyst sulfiding procedures                                                                                                                              |
| <b>K. J. Smith, R. G. Herman and K. Klier</b>                                  | 2639 | F12. Kinetic modelling of higher alcohol synthesis over alkali-promoted Cu/ZnO and MoS <sub>2</sub> catalysts                                                             |
| <b>R. F. Hicks, H. Qi, M. L. Young, R. G. Lee, W. J. Han and A. B. Kooh</b>    | 2647 | F13. Effect of catalyst structure on the rate of alkane oxidation over platinum                                                                                           |
| <b>A. E. Rodrigues and R. M. Quinta Ferreira</b>                               | 2653 | F14. Effect of intraparticle convection on the steady-state behavior of fixed-bed catalytic reactors                                                                      |

|                                                                                            |      |                                                                                                                                                                      |
|--------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S. Kito, T. Hattori and Y. Murakami                                                        | 2661 | F15. An expert systems approach to computer-aided design of multi-component catalysts                                                                                |
| K. Schnitzlein and A. Löwe                                                                 | 2671 | <b>Session G: environmental</b><br>G1. Numerical simulation of the performance of ceramic fiber coil diesel particulate traps                                        |
| G. Centi, A. Riva, N. Passarini, G. Brambilla, B. K. Hodnett, B. Delmon and M. Ruwet       | 2679 | G2. Simultaneous removal of $\text{SO}_2/\text{NO}_x$ from flue gases. Sorbent/catalyst design and performances                                                      |
| B. Ruggeri, P. Tundo and W. Tumiatti                                                       | 2687 | G3. Supported liquid phase reactor (SLPR) for PCBs in oil decontamination                                                                                            |
| B. F. Hagh and D. T. Allen                                                                 | 2695 | G4. Catalytic hydroprocessing of chlorinated benzenes                                                                                                                |
| M. Lovo, H. A. Deans and V. Balakotaiah                                                    | 2703 | G5. Modeling and simulation of aqueous hazardous waste oxidation in deep well reactors                                                                               |
| G. W. Roberts, D. M. Brown, T. H. Hsiung and J. J. Lewnard                                 | 2713 | <b>Session H: alternate energy</b><br>H1. Catalyst poisoning during the synthesis of methanol in a slurry reactor                                                    |
| M. Weeda, P. J. J. Tromp and J. A. Moulijn                                                 | 2721 | H2. The potential of coal gasification in a novel iron oxide reduction process                                                                                       |
| F. Goudriaan and D. G. R. Peferoen                                                         | 2729 | H3. Liquid fuels from biomass via a hydrothermal process                                                                                                             |
| J. J. Lewnard, T. H. Hsiung, J. F. White and D. M. Brown                                   | 2735 | H4. Single-step synthesis of dimethyl ether in a slurry reactor                                                                                                      |
| K. Yokota, Y. Hanakata and K. Fujimoto                                                     | 2743 | H5. Supercritical phase Fischer-Tropsch synthesis                                                                                                                    |
| R. E. Hogan, Jr., R. D. Skocynec, R. B. Diver, J. D. Fish, M. Garratt and J. T. Richardson | 2751 | H6. A direct absorber reactor/receiver for solar thermal applications                                                                                                |
| S. E. Zarkanitis, E. A. Efthimiadis and S. V. Sotirchos                                    | 2761 | <b>Session I: homogeneous kinetics/polymers</b><br>I1. Experimental evaluation of a class of distributed pore size models for gas-solid reactions with solid product |
| A. Chakma and M. R. Islam                                                                  | 2769 | I2. Modelling of visbreaking of bitumen in a jet reactor                                                                                                             |
| J. F. Paizer II, S. K. Wolfson Jr and S. J. Yao                                            | 2777 | I3. Reactor control and reaction kinetics for electrochemical urea oxidation                                                                                         |
| M. A. Dubé, A. Penlidis and K. F. O'Driscoll                                               | 2785 | I4. Mathematical modelling of styrene/butyl acrylate copolymerization                                                                                                |
| T. Meyer and A. Renken                                                                     | 2793 | I5. Characterization of segregation in a tubular polymerization reactor by a new chemical method                                                                     |
| S. J. Tremont, E. E. Remsen and P. L. Mills                                                | 2801 | I6. An experimental and modelling study of polybutadiene functionalization to polyaldehydes using a homogeneous rhodium catalyst                                     |
|                                                                                            | 2809 | Author Index                                                                                                                                                         |

## Number 9

|                                         |      |                                                                             |
|-----------------------------------------|------|-----------------------------------------------------------------------------|
| M. M. El-Halwagi and V. Manousiouthakis | 2813 | Automatic synthesis of mass-exchange networks with single-component targets |
|-----------------------------------------|------|-----------------------------------------------------------------------------|

|                                                                                 |      |                                                                                                                                                   |
|---------------------------------------------------------------------------------|------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| O. J. Smith IV and<br>A. W. Westerberg                                          | 2833 | Mixed-integer programming for pressure swing adsorption cycle scheduling                                                                          |
| J. Gyenis and F. Kárai                                                          | 2843 | Determination and randomness in mixing of particulate solids                                                                                      |
| R. O. Fox and J. Villermaux                                                     | 2857 | Micromixing effects in the $\text{ClO}_2^- + \text{I}^-$ reaction: perturbation analysis and numerical simulation of the unsteady-state IEM model |
| Y. D. Chen, J. A. Ritter<br>and R. T. Yang                                      | 2877 | Nonideal adsorption from multicomponent gas mixtures at elevated pressures on a 5A molecular sieve                                                |
| A.-F. A. Asfour and A. H. Nhaesi                                                | 2895 | An improved model for mass transfer in three-phase fluidized beds                                                                                 |
| K. T. Yu, J. Huang, J. L. Li<br>and H. H. Song                                  | 2901 | Two-dimensional flow and eddy diffusion on a sieve tray                                                                                           |
| Y.-L. Hwang and F. G. Helfferich                                                | 2907 | Dynamics of continuous countercurrent mass-transfer processes—IV. Multicomponent waves and asymmetric dynamics                                    |
| P. E. Grimshaw, A. J. Grodzinsky,<br>M. L. Yarmush and<br>D. M. Yarmush         | 2917 | Selective augmentation of macromolecular transport in gels by electrodiffusion and electrokinetics                                                |
| J. D. Landgrebe, S. E. Pratsinis<br>and S. V. R. Mastrangelo                    | 2931 | Nomographs for vapor synthesis of ceramic powders                                                                                                 |
| Wang Shaoting, Zhang Fengbao,<br>Ma Tengxiang and Gu Hanqing                    | 2943 | Investigation on patient-artificial kidney system using compartment models                                                                        |
| M. Dekker, K. Van't Riet,<br>B. H. Bijsterbosch, P. Fijneman<br>and R. Hilhorst | 2949 | Mass transfer rate of protein extraction with reversed micelles                                                                                   |
| <i>Shorter Communications</i>                                                   |      |                                                                                                                                                   |
| S. S. Elshishini and<br>S. S. E. H. Elnashaie                                   | 2959 | Digital simulation of industrial fluid catalytic cracking units—II. Effect of charge stock composition on bifurcation and gasoline yield          |
| S. S. E. H. Elnashaie<br>and M. E. Abashar                                      | 2964 | The implication of non-monotonic kinetics on the design of catalytic reactors                                                                     |
| D. Lj. Petrović, D. Poštarac,<br>A. Duduković and D. Skala                      | 2967 | Mixing time in gas-liquid-solid draft tube airlift reactors                                                                                       |
| A. Seidel                                                                       | 2970 | Calculating chemical reaction equilibrium for a homogeneous phase from the material balance of a batch reactor                                    |
| J. C. Merchuk and R. Yunker                                                     | 2973 | The role of the gas-liquid separator of airlift reactors in the mixing process                                                                    |
| G. Azar and A. Tamir                                                            | 2976 | Dissolution of solids in a continuous impinging-streams contactor with two tangential pairs of liquid feeds: experiments and modeling             |
| C. Schaller and G. Kreysa                                                       | 2979 | Measurement of fluid-fluid mass transfer with experimental elimination of dispersion effects                                                      |
| W. Blümel and P. Käferstein                                                     | 2982 | An approach to determining the axial mass transfer in the gas phase in coarse-grained gas-solid fluidised beds                                    |

|                                              |                                                                                                                                                                                                                                                                                |
|----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| N. Watanabe, S. Ohbayashi and H. Kurimoto    | 2984 Application of the infinite-frequency pi criterion to a periodically operated isothermal CSTR                                                                                                                                                                             |
| J.-Y. Day                                    | 2987 The fountain height and particle circulation rate in a spouted bed                                                                                                                                                                                                        |
| E. N. Rudisill and M. D. LeVan               | 2991 Analytical approach to mass transfer in laminar flow in reactive hollow fibers and membrane devices with non-linear kinetics                                                                                                                                              |
| M. Punčochář, J. Drahoš and J. Čermák        | 2994 The limits of applicability of pressure drop correlations                                                                                                                                                                                                                 |
| K. S. Gandhi and R. Kumar                    | 2998 An elongational flow model for drop breakage in stirred turbulent dispersions                                                                                                                                                                                             |
| C.-L. Chiang and C. H. Yu                    | 3002 Optimal pore size of catalysts for hydrodemetallation reactions                                                                                                                                                                                                           |
| W. Chen, R. R. Fisher and J. C. Berg         | 3003 Simulation of particle size distribution in an aggregation-breakup process                                                                                                                                                                                                |
| D. G. Retzloff, P. C.-H. Chan and M. Starzak | 3007 <i>Letters to the Editors</i><br>Comments on singular points in the problem of steady-state multiplicity for the stirred tank reactor with consecutive reactions                                                                                                          |
| Z. Rojkowski                                 | 3007 Comments on growth and dissolution kinetics of potassium sulphate crystals in aqueous 2-propanol solutions                                                                                                                                                                |
| A. G. Jones and J. Mydlarz                   | 3009 Authors' reply to comments of Z. Rojkowski                                                                                                                                                                                                                                |
| F. Kolenda, J. P. Reymond and G. Dessalles   | 3011 <i>Book Reviews</i><br>Catalyst Design—Progress and Perspectives. Edited by L. L. Hegedus                                                                                                                                                                                 |
| G. A. Davies                                 | 3011 Granular Filtration of Aerosols and Hydrosols. By C. Tien                                                                                                                                                                                                                 |
| H. Hofmann                                   | 3012 DECHEMA Chemistry Data Series. Edited by D. Behrens and R. Eckermann. Vapor-Liquid Equilibria for Mixtures of Low Boiling Substances. By H. Knapp, S. Zeck and R. Langhorst. Thermal Conductivity and Viscosity Data of Fluid Mixtures. By K. Stephan and T. Heckenberger |
| M. S. Spencer                                | 3012 Laboratory Studies of Heterogeneous Catalytic Processes. By E. G. Christoffel (revised and edited by Z. Paal)                                                                                                                                                             |
| T. R. Bott                                   | 3013 Heat Exchanger Design. By A. P. Fraas                                                                                                                                                                                                                                     |
|                                              | 3015 Corrigenda                                                                                                                                                                                                                                                                |
| Number 10                                    |                                                                                                                                                                                                                                                                                |
| P. J. McLellan, T. J. Harris and D. W. Bacon | 3017 Review Article Number 33. Error trajectory descriptions of nonlinear controller designs                                                                                                                                                                                   |
| E. M. Besher and A. Meisen                   | 3035 Low-temperature fluidized-bed Claus reactor performance                                                                                                                                                                                                                   |
| A. Lübbert and B. Larson                     | 3047 Detailed investigations of the multiphase flow in airlift tower loop reactors                                                                                                                                                                                             |
| C. Tsuris, L. L. Tavlarides and J. C. Bonnet | 3055 Application of the ultrasonic technique for real-time holdup monitoring for the control of extraction columns                                                                                                                                                             |

|                                                                             |                                                                                                                                                              |
|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Guan Jianyu and Ye Zhenhua</b>                                           | 3063 Analog circuit for simulation of pressure swing adsorption                                                                                              |
| <b>B. J. Ennis, J. Li, G. I. Tardos and R. Pfeffer</b>                      | 3071 The influence of viscosity on the strength of an axially strained pendular liquid bridge                                                                |
| <b>J. Sabaté, S. Cervera-March, R. Simarro and J. Giménez</b>               | 3089 Photocatalytic production of hydrogen from sulfide and sulfite waste streams: a kinetic model for reactions occurring in illuminated suspensions of CdS |
| <b>R. Font and J. M. Lopez</b>                                              | 3097 Kinetics of insoluble-substrate fermentation in mixed continuous-flow systems                                                                           |
| <b>Y. W. Nam, R. R. Hudgins and P. L. Silveston</b>                         | 3111 Storage models for ammonia synthesis over iron catalyst under periodic operation                                                                        |
| <b>P. Basu</b>                                                              | 3123 Heat transfer in high temperature fast fluidized beds                                                                                                   |
| <b>R. Sant and E. E. Wolf</b>                                               | 3137 Elementary-step modeling and transient FTIR studies of CO oxidation on Rh/SiO <sub>2</sub>                                                              |
| <b>W. J. A. Wammes, S. J. Mechielsen and K. R. Westerterp</b>               | 3149 The transition between trickle flow and pulse flow in a cocurrent gas-liquid trickle-bed reactor at elevated pressures                                  |
| <b>K. B. van Gelder, J. K. Damhof, P. J. Kroijenga and K. R. Westerterp</b> | 3159 Three-phase packed bed reactor with an evaporating solvent—I. Experimental: the hydrogenation of 2,4,6-trinitrotoluene in methanol                      |
| <b>K. B. van Gelder, P. C. Borman, R. E. Weenink and K. R. Westerterp</b>   | 3171 Three-phase packed bed reactor with an evaporating solvent—II. Modelling of the reactor                                                                 |
| <b>P. N. Reddy, D. P. Rao and M. S. Rao</b>                                 | <i>Shorter Communication</i><br>3193 The texture of liquid flow in trickle-bed reactors                                                                      |
| <b>C. Yao</b>                                                               | <i>Letters to the Editors</i><br>3199 Comments on the relative importance of pore and surface diffusion in non-equilibrium adsorption rate processes         |
| <b>R. G. Rice and D. D. Do</b>                                              | 3200 Authors' reply to comments by C. Yao                                                                                                                    |
| <b>L. G. Gibilaro and P. U. Foscolo</b>                                     | 3201 Comments on generalization of the Foscolo-Gibilaro analysis of dynamic waves                                                                            |
| <b>D. D. Joseph</b>                                                         | 3202 Author's reply to comments by L. G. Gibilaro and P. U. Foscolo                                                                                          |
| <b>Number 11</b>                                                            |                                                                                                                                                              |
| iii Danckwerts-Maxwell Prize                                                |                                                                                                                                                              |
| <b>R. H. Davis and J. D. Sherwood</b>                                       | 3203 A similarity solution for steady-state crossflow microfiltration                                                                                        |
| <b>L. J. Kelsey, M. R. Pillarella and A. L. Zydney</b>                      | 3211 Theoretical analysis of convective flow profiles in a hollow-fiber membrane bioreactor                                                                  |
| <b>R. Yadav and R. G. Rinker</b>                                            | 3221 An experimental study of methane synthesis by concentration forcing                                                                                     |
| <b>M. Mattea, M. J. Urbicain and E. Rotstein</b>                            | 3227 Prediction of thermal conductivity of cellular tissues during dehydration by a computer model                                                           |
| <b>R. Roy, J. F. Davidson and V. G. Tuponogov</b>                           | 3233 The velocity of sound in fluidised beds                                                                                                                 |

**J. I. Morell and N. R. Amundson** 3247 The combustion behavior of retorted shale particles

**A. Kapoor and R. T. Yang** 3261 Surface diffusion on energetically heterogeneous surfaces—an effective medium approximation approach

**N. R. Anturkar,  
T. C. Papamastasiou and  
J. O. Wilkes** 3271 Lubrication theory for  $n$ -layer thin-film flow with applications to multilayer extrusion and coating

**M. H. Oyevaar,  
R. W. J. Morssinkhof and  
K. R. Westerterp** 3283 The kinetics of the reaction between  $\text{CO}_2$  and diethanolamine in aqueous ethyleneglycol at 298 K: a viscous gas-liquid reaction system for the determination of interfacial areas in gas-liquid contactors

**C.-C. Yu and M. K. H. Fan** 3299 Decentralized integral controllability and D-stability

**X.-L. Yang, J.-P. Euzen and  
G. Wild** 3311 Residence time distribution of the liquid in gas-liquid cocurrent upflow fixed-bed reactors with porous particles

**H. Orbey and J. H. Vera** 3319 The simplest cubic equation of state for low-pressure vapor-liquid equilibrium calculations

**G. W. Johnson and R. S. Kapner** 3329 The dependence of axial dispersion on non-uniform flows in beds of uniform packing

**J. Alvarez, R. Suárez and  
A. Sánchez** 3341 Nonlinear decoupling control of free-radical polymerization continuous stirred tank reactors

**H. V. Nordén and M. A. Pekkanen** 3359 A coordinate transformation for mass transfer calculations

**D. Barnea and Y. Taitel** 3367 Nonlinear stability and dynamic simulation of annular flow

**H. Hofmann and J. Bridgwater** 3373 Editorial statement

**M. P. Duduković and Y. B. Yang** 3375 Solution of moving boundary problems for gas-solid noncatalytic reactions by orthogonal collocation—revisited

**D. D. Perlmutter and B. Scrosati** 3381 *Shorter Communications*  
A thin-film model for diffusion-controlled electrochemical doping of polymers

**R. E. Valdés-Pérez** 3384 A correspondence between reaction network equilibria and Boolean functions

3387 Corrigendum

## Number 12

**R. L. Wu, J. R. Grace and C. J. Lim** 3389 A model for heat transfer in circulating fluidized beds

**G. Astarita and R. Ocone** 3399 Continuous lumping in a maximum-mixedness reactor

**J. Benítez-García, G. Ruiz-Ibáñez,  
A. Bidarian and O. C. Sandall** 3407 Kinetics of the reaction between carbon dioxide and triethylamine in aqueous solutions

**D. Bonvin and D. W. T. Rippin** 3417 Target factor analysis for the identification of stoichiometric models

**A. Irabien, F. Cortabitarte, J. Viguri  
and M. I. Ortiz** 3427 Kinetic model for desulfurization at low temperatures using calcium hydroxide

|                                                                     |      |                                                                                                                       |
|---------------------------------------------------------------------|------|-----------------------------------------------------------------------------------------------------------------------|
| <b>L. Gradoń and A. Podgóński</b>                                   | 3435 | Flexible fibrous particle behaviour in the carrier gas flow around cylindrical obstacle                               |
| <b>E. J. Westerink, N. Koster and K. R. Westerterp</b>              | 3443 | The choice between cooled tubular reactor models: analysis of the hot spot                                            |
| <b>S. Rohani and J. R. Bourne</b>                                   | 3457 | Self-tuning control of crystal size distribution in a cooling batch crystallizer                                      |
| <b>S. Park and W. F. Ramirez</b>                                    | 3467 | Optimal regulatory control of bioreactor nutrient concentration incorporating system identification                   |
| <b>F. Wassmuth, W. G. Laidlaw and D. A. Coombe</b>                  | 3483 | Interfacial instabilities: the Linde instability                                                                      |
| <b>T. Tobin, R. Muralidhar, H. Wright and D. Ramkrishna</b>         | 3491 | Determination of coalescence frequencies in liquid-liquid dispersions: effect of drop size dependence                 |
| <b>P. Psarris and C. A. Floudas</b>                                 | 3505 | Improving dynamic operability in MIMO systems with time delays                                                        |
| <b>P. A. Ramachandran</b>                                           | 3525 | Diffusion-reaction problem revisited via a new boundary element discretization                                        |
| <b>T. O. Odi and I. A. Karimi</b>                                   | 3533 | A general stochastic model for intermediate storage in noncontinuous processes                                        |
| <b>M. Masi, S. Carrà, M. Morbidelli, V. Scaravaggi and F. Preti</b> | 3551 | Monodimensional model of cold-wall reactors for epitaxial silicon chemical vapor deposition                           |
| <b>J. Vohradský and H. Sovová</b>                                   | 3563 | Measurement of local velocities of drops in a liquid-liquid extraction vibrating plate column                         |
| <b>R. O. Fox, W. D. Curtis and K. Halasi</b>                        | 3571 | Linear stability analysis of the unsteady-state IEM model of micromixing                                              |
| <b>A. Cingara, M. Jovanovic and M. Mitrovic</b>                     | 3585 | Analytical first-order dynamic model of binary distillation column                                                    |
| <b>S. P. Godbole, A. Schumpe and Y. T. Shah</b>                     | 3593 | <i>Shorter Communication</i><br>The effect of solid wettability on gas-liquid mass transfer in a slurry bubble column |